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ABSTRACT

Forty-eight pupils from grades one, three, and five participated in a study of the extent to which children are able to use their prior knowledge and expectancies to aid them in integrating verbal material and in drawing appropriate inferences. Six stories were constructed for each of four inference levels, and 11 questions were prepared for each story. Order of stories was counterbalanced across the three sessions in which they were administered to the children. The picture of language development which emerges from this study is that at first children learn to draw inferences from information which assumes or maps onto their prior knowledge; second, they learn to draw the necessary implications from arbitrary material; and third, they learn to draw the necessary implications from information which contradicts their prior world knowledge. Alternatively, development consists of learning to detach oneself from what is known and to constrain one's interpretation of linguistic information to what is explicitly stated, an ability which several authors have suggested appears to be a consequence of formal schooling. (AA)

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Children's abilities to draw inferences from oral material

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At least three processes are involved in the interpretation of sentences: relating the information to prior knowledge (Bransford and Johnson, 1973); integrating the information (Bransford, Barclay and Franks, 1972); and going beyond the information to produce inferences (Kintsch, 1974; Schank, 1975). This paper addresses the extent to which children are able to use their prior knowledge and expectancies to aid them in integrating verbal material and in drawing appropriate inferences.

Past research on integrative and inferential abilities has produced disparate findings. It is generally assumed (e.g., Bransford & Franks, 1972; Anderson & Ortony, 1975) that these abilities are spontaneous in adults, but it is not clear that this is the case with young children.

Piaget (1958, 1972) maintains that children under 11 to 12 years, given the following verbal propositions:

1a. Edith is light than Suzanne

1b. Edith is darker than Lily

are unable to produce the implication

1'. Lily is lighter than Suzanne.

Frase's (1972 findings with text comprehension fully support this conclusion. However, Trabasso (1975), using similarly structured material, taught 4 year olds the pairwise information (i.e., that A is bigger than B) until they could recall it perfectly and subsequently obtained performance ranging between 94 and 100% correct on the Inference questions. Trabasso concluded that children as young as four years are able to draw such implications[1] quite easily, once the appropriate representations are constructed and over learned.

Moeser (1975) and Paris and his associates (Paris & Carter, 1973; Paris & Mohoney, 1974) have tested inferential ability using less formally structured material, such as:

2a. The bird is in the cage.

2b. The cage is under the table.

Inference 2'. The bird is under the table.

Paris found that children from grades 2 and 5 were unable to distinguish between the inference statement (2') and the premise statements (2a and 2b) indicating that the children had stored the integrated information in memory. Moeser, on the other hand, found that kindergarten through College age students, in a force-choice test, correctly selected the true Inference statements only 60-66% of the time, performance which was little higher than chance.

In a further experimental paradigm Paris and Upton (1976), and Macnamara, Baker and Olson (1976) read young children stories and then asked a series of Yes/No, Premise and Inference questions some of which were based on "implicative" verbs such as forget, manage, etc. Paris and Macnamara concluded that the ability to produce inferences is spontaneous since even four year olds were producing close to perfect inference scores. They found that children as young as four years could verify the true Inference statements approximately 80 to 90% of the time, leading them to conclude that the ability to produce inferences is spontaneous.

To account for and extend further the disparate findings from these various studies, we proposed that inferences are categorized according to their degree of reference to world knowledge. At one end of the continuum are formal implications (Level 1 Inferences) which are made with no recourse to world knowledge other than that formally conventionalized in the sentence per se. At the other end are inferences which require obligatory

reference to implicit world knowledge (Level 4 Inferences). Consider now these various inference levels, depicted in Figure 1, in further detail.

Insert Figure 1 about here

Level 1: FORMAL INFERENCES

Level 1 (L1) Inferences are formal implications derived from explicitly presented information. They are made with no recourse to known situations. An example is as follows:

3a. The policeman is in front of the clown.

3b. The garbageman is behind the clown.

Inference

3'. The policeman is in front of the garbageman.

The concepts which are used are arbitrary: there is no a priori reason why the three concepts should be ordered policeman, clown, garbageman. The formal, logical structure of the information is such that the implication is necessarily derived, from the logical structure of the sentences themselves.

Level 2: MEANINGFUL INFERENCES

L2 Inferences bear a structure similar to the formal structure of L1 Inferences, but the concepts are utilized in a way which conforms to world knowledge. The concepts taken in isolation are as arbitrary as those used for L1 Inferences but additional information in the material serves to provide a meaningful rationale or motivation for the particular ordering. An example, describing a parade, is as follows:

4a. The policeman, on his horse, was in front of the clowns, clearing the way for the parade.

4b. The garbageman was behind the clowns, collecting the candy wrappers from the candies the clowns gave to the kids on the sidewalk.

Inference

4'. The policeman was in front of the garbageman.

Note that exactly the same concepts were used in Example 4 as were used in Example 3, but in 4 additional causal information drawing upon specific features of the concepts provided a rationale for the ordering of the concepts.

COUNTER FACTUAL INFERENCES

Although Counter Factual Inferences are not included in Figure 1, they do constitute a separate inference level. Counter Factual Inferences are derived from material which is formally structured, as in L1 and L2, but the concepts are ordered in a manner which contradicts general knowledge. For example:

5a. The mouse is bigger than the goat.

5b. The goat is bigger than the horse.

Inference

5'. The mouse is bigger than the horse.

The formal structure of the material results in 5' even thought 5a and 5b clearly violate what we know to be true.

Level 3: INTEGRATION INFERENCES

While L3 Inferences require the integration of units of information as do L1 and L2 Inferences, the material is not formally structured,

but more closely resembles normal discourse. L3 Inferences require the subject to integrate information but then to apply some knowledge of the world to decide if the inference is valid. Consider the following examples:

6a. On the river is a bridge.
6b. Under the bridge is a barge.

Inference

6'. The barge is on the river.

7a. On the river is a leaf.
7b. Under the leaf is a fish.

Inference

7*. The fish is on the river.

In both 6 and 7 the same spatial terms are used but while it is perfectly correct to infer 6', that the barge is on the river, in /* it cannot be inferred that the fish is on the river. The subjects' knowledge of the world permits 6' but not 7*.

Clearly, then, L3 Inferences are not the necessary implications of explicitly presented information, but require that the subject utilize general world knowledge to decide if the inference is valid.

Level 4: IMPLICIT INFERENCES

L4 Inferences require obligatory reference to implicit world knowledge and the subject is required to produce inferences which are implicit. For example:

9. One day Susan was sitting in the shade playing. All of a sudden she saw something on the ground. She ran inside to find a box and put the small white thing in it. Next morning her teacher gave the class a lesson on how moths hatch.

Inferences

The sun was shining.

Susan took the thing to school.

Susan found a crysallid.

It is important to note that L4 Inferences are 'probably but not necessarily true'. So, for example, the information that the teacher taught a lesson on crysallids and that the object Susan found could fit the description of a crysallid, lead one to infer that this is what Susan found. However, it is equally feasible that she found a stone, an egg, or any item that is both small and white.

Do children's abilities, to draw inferences, reflect the categorization of inferences set out above? Or do inferences having a particular logical structure develop all together? The importance, for young children, of being able to use context and world knowledge in general language comprehension has been well documented (Bloom, 1970; Brown, 1973; Macnamara, 1972). Recent research with older children (Harris, 1975; Klein, Klein & Bertino, 1976; Olson & Nickerson, 1974) and with adults (Anderson & Ortony, 1975) reaffirms the importance of the availability of a sound general knowledge base in many language comprehension tasks.

On the basis of this research, we may predict that the more knowledge of the world that can be applied in integrating material and in drawing inferences, the easier those inferences will be to produce: references requiring no world knowledge (Level 1) should be harder than those requiring implicit, non-specified knowledge (Level 4). In addition, since younger children appear to place more reliance upon world knowledge

in language comprehension tasks, developmental differences may be expected in the production of implications (here, Level 1 Inferences) but not the production of Implicit Inferences. Moreover, since the production of Counter Factual inferences results in a violation of world knowledge, we may expect young children to produce inferences which violate the given information, while older children will honour the given information and vilate their knowledge of the world. In other words, we predict a general development from a leliance upon world knowledge to a reliance upon the logical properties of the statements themselves.

METHOD

Materials. Separate stories, appropriate for each of the Inference types, were prepared. The structure of the material for L1, L2 and CF Inferences was relatively formal and as such these stories may be referred to as Texts. Texts described a linear array of four concepts. The array was described spatially, using the relational pairs In Front/Behind, and On Top/Under (with one pair per story), comparatively, using the terms Bigger/Smaller, More/Less, and temporally using the terms Before/After, Earlier/Later. This resulted in six different stories per Inference level. Examples of stories, classified according to inference type, one shown in Table 1.

Insert Table 1 about here

The array of concepts described in the texts appropriate for L1 Inferences, FORMAL TEXTS, was completely arbitrary. Neither the total array nor any individual pair of concepts were ordered in a meaningful manner. In addition to describing the array, the story contained information about the concepts, such as colour, size, etc., plus sufficient non-relevant information to make the story interesting.

The array of concepts described in the MEANINGFUL TEXTS, from which L2 Inferences were derived, was potentially arbitrary. However, the stories contained additional information pertaining to specific features of the concepts which provided a causal relationship between the individual pairs of concepts. In other words, this causal information provided a rationale for the linear array being ordered in the way presented.

In the COUNTER FACTUAL TEXTS the array of concepts was described in a manner which contradicted world knowledge, resulting in Counter Factual Inferences. All other story information, however, was perfectly congruent with general knowledge.

A total of 18 Text stories were written, one for each pair of relational terms for each Inference level. The use of the marked/unmarked terms of each relational pair, the order of mention of the concepts, etc. were matched as closely as possible across the three different story types.

Eleven questions were prepared for each story. Three questions pertained to Inferences, three questions pertained to Propositions or the premises upon which those Inferences were based, and five Memory questions referred to non-relevant story details. Most questions were forced choice, requiring the selection of one of a pair of concepts or one of a pair of relational terms. A few questions required Yes/No as a response and small number (generally Memory questions) were open ended. Since it is conceivable that answers given to questions presented at the beginning of the list could influence those presented later, all inference questions were asked before the proposition questions, and the memory questions were interspersed amongst those. An attempt was made to

match specific question type and question order across inference levels.

The structure of the NARRATIVE stories, appropriate for L3 and L4 Inferences was not formal and more closely resembled regular children's stories. While in the Textual stories only one type of array (spatial, temporal or comparative) was described, in the Narratives many different relationships were described in a single story.

Four Narrative stories were written. As they were longer than Text stories and were accompanied by a greater number of questions, each story was presented serially in two sections, accompanied by an appropriate set of questions. An example is shown in Table 1.

The questions for the Narrative stories were of three types: L3 Inference questions, L4 Inference questions and Memory for non-relevant details. Most questions were forced choiced, requiring the selection of the correct concept or preposition etc. Several of the Memory and Level 4 Inference questions were open ended.

Subjects: A total of 48 children attending a local separate school, St. Thomas Moore, participated in the study. Eight boys and eight girls were selected from Grades 1, 3 and 5. Four high, eight average and four low ability children were chosen at each grade level. All were native English speakers.

Design and Procedure: The order of presentation of the Formal Text, Meaningful Text and Narrative stories was counter balanced, as was the order of the specific stories within each story type. The appropriate questions for the stories were collated into booklets in these predetermined orders. Two booklets per child were prepared, each containing

approximately one half of the stories. The order of presentation of specific Counter Factual stories was also counter balanced and the question sheets were collated into a third separate booklet.

The general procedural instructions were similar for all grade levels. The children were informed that they would hear some stories and that they should try to remember what they had heard as they would have to answer questions. Care was taken to ensure that all children understood the mechanics of forced-choice questions.

The Grade 3 and Grade 5 children were seen in pairs. The experimenter read each story and then read out the appropriate questions. The children read the questions at the same time and marked their responses on the answer sheet. Each child was given a cardboard sheet with a rectangular hole cut from the centre to place over the answer sheet so that only one question was visible at a time.

The Grade 1 children were seen individually. They heard the story and then the questions, responding verbally to the questions. The experimenter marked their responses on the sheets. Care was taken to ensure that they were fully aware of the instructions for the Counter Factual stories.

The children were seen on three separate occasions, with one day between the first two sessions, at which times the Formal Text, Meaningful Text and Narrative stories were given. At least two days separated the second and third sessions. It was on this final session that the Counter Factual stories were given. The first two sessions lasted approximately 30 mins. each and the last one 15 to 20 mins.

Results

The first step in the data analysis involved the scoring of the open ended questions. Open ended Memory questions provided no room for debate: the child either did or did not get the answer correct based on the information in the story. Scoring of the open ended L4 Inference questions was more difficult. Two criteria were followed: first that the answer should be more than just a reference to world knowledge; and second, that the answer must accord with the additional information in the story. For example, in the Narrative story, 'The Kitten,' one question asks "Who knocked at the door?" The responses 'a man', 'a lady', 'a stranger', were all marked as incorrect, since while according to one's knowledge of the world they are potentially correct responses, the additional information in the story can be used to refine that answer. Thus 'a mailman,' 'a delivery man,' 'a Simpson-Sears man' were all included as correct.

All open ended L4 Inference questions were scored by two independent raters. Agreement was very high and any differences of opinion were resolved to the mutual satisfaction of both raters.

An information system was written to score and tabulate the raw data. The output from this programme, categorized according to specific story, question type and subjects, formed the basis for the subsequent analyses.

To determine the effect of inference level and grade level one inferential ability, two major analyses were computed. The first was an Analysis of Covariance for repeated measures. The covariance design was used to

ensure that differences in Inference scores at different grade levels were not due simply to memory differences at the three grade levels. The criterion was the proportion correct Inference score at each level, summed across stories within levels. The covariate was the proportion correct Memory score at each level, again summed across stories within levels.[2]

The three-way ANCOVA (Grade x Subjects (Grade) x Inference Level) revealed the following significant effects: Grade ($F(2,45) = 6.98$, $p < 0.01$); Inferences level ($F4,179) = 45.53$, $p < 0.001$); Grade x Inference level ($F(8,179) = 3.26$, $p < 0.01$). To ensure that the results are generalizable across stories as well as subjects, two F_2 analyses of covariance, using stories as a random factor, were computed. The F_2 ANCOVA computed on the Textual story data revealed significant effects due to Grade ($F_2(2,30) = 34.00$, $p<0.001$) Inference level ($F_2(2,15) = 33.86$, $p < 0.001$), with the interaction of Grade x Inference level tending to significance ($F_2(4,30) = 2.57$, $p < 0.1$). The F_2 ANCOVA computed on the Narrative story data also revealed significance main effects of Grade ($F_2(2,14) = 5.99$, $p < 0.05$), and Inference level ($F_2(1,7) = 10.65$, $p < 0.05$), with a significant Grade x Inference level interaction ($F_2(2,14) = 4.00$, ($p < 0.05$). Since the obtained F and F_2

ratios are significant for comparable comparisons, we may assume that the results are generalizable over different subjects and different stories, (Clark, 1973, p. 348).

A posteriori comparisons, using the Scheffe test, were performed on the adjusted means. The Inference level means were not in the order predicted by the categorization described earlier (see Figure 1) but were ordered, for increasing ease of production as follows: CF, L1, L3, L4, L2. The Scheffé test indicated that the CF and L1 Inferences were significantly harder than all others and that the L4 and L2 Inferences were significantly easier (see Figure 2). Although the data do not con-

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Insert Figure 2 about here

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firm the predicted order of Inference Levels, they do indicate that knowledge of the world is an important variable.

A posteriori comparisons on the adjusted means for the significant main effect of Grade level revealed that, not surprisingly, the Grade 5 children performed significantly better than the Grade 1 and Grade 3 children. However, the significant Grade x Inference level interaction indicated that the Grade level differences were not consistent across the five Inference types. Tests for simple main effects showed that there were significant differences at each Grade level and for all Inference types except for L4 or Implicit Inferences. Scheffe tests on the adjusted means indicated the following: for the Counter Factual Inferences, the Grade 5 children did significantly better than the Grade 1 and Grade 3 children; for the L1 (Formal) inferences the Grade 1 children did signi-

ficantly less well than the Grade 3 and Grade 5 children, supporting the hypothesis that the younger children would have difficulty with these Formal Inferences; for L3 (Integration) and L2 (Meaningful) Inferences, the Grade 5 children did significantly better than the Grade 1 and Grade 3 children and there no significant differences between the two younger grades; no comparisons were made on the L4 (Implicit) Inferences as the tests for simple main effects indicated that there was no main effect, thus supporting the prediction that young children would easily be able to produce Implicit Inferences.

The interaction, then, which is depicted in Figure 3, shows that when the child is required to draw inferences based upon the explicitly presented information, the older children performed at a higher level. However, on those inferences requiring reference to world knowledge, the youngest children performed as well as the older ones.

Insert Figure 3 about here

For three of the inference types, Counter Factual (CF), Formal (L1) and Meaningful (L2), scores were obtained not only for inference and memory questions but also for proposition or premise questions. An analysis was computed on the differences between the Inference and Proposition scores in an attempt to determine whether the facilitating effect of world knowledge on Inference scores was matched by a similar facilitation on Proposition scores.

In earlier research (e.g., Potts, 1974; Scholz & Potts, 1974; Trabasso, 1975) it has generally been found that performance on Inferences is better than on Propositions. Therefore, in this study we may expect that Inference scores will

be equal to or greater than Proposition scores. Accordingly, the (Inference - Proposition) score for CF, L1 and L2 Inferences served as the dependent variable in an analysis of variance for repeated measures. The main effect of Inference level proved to be significant ($F(2,90) = 11.84$, $p < 0.01$) as did the interaction of Grade with Inference level ($F(4,90) = 2.48$, $p < 0.05$). The Inference level means were ordered CF, L1, L2 and an a posteriori comparison of these means indicated that the difference score for L2 Inferences was significantly greater than the difference scores for L1 and CF Inferences. The significant interaction however, indicated that this effect was not constant across the three Grade levels. A test for simple main effects revealed a significant effect of Inference level only for the Grade 1 children. The means for the Grades 3 and 5 children, although in the right direction, did not attain the 0.05 level of significance (see Figure 4). Thus, it was the

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Insert Figure 4 about here

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youngest children who best utilized the additional causal information in the Meaningful Texts to improve their Inference scores.

Discussion

The intent of this study was two fold: firstly, to show that the general knowledge and proior expectancies, so important to the comprehension of ordinary oral language, facilitates the production of inferences; and secondly, to show that as the amount of required world

knowledge increases, developmental differences in inferential ability decrease. In other words, development occurs primarily for formal implications.

The data clearly show that increasing the amount of world knowledge that can be used to draw an inference, significantly facilitated inference production. The inference scores for all grade levels increased as the inferences changed from Counter Factual to Meaningful in the Text stories, and from Integration to Implicit in the Narratives.

That the children were capitalizing upon their knowledge of the world in producing inferences is also indicated by the analysis of the difference scores. The Inference score far exceeded the Proposition score for Meaningful texts while it was closer to the Proposition score for the Formal and Counter Factual Texts. Not only were the children utilizing the causal information and rationale for the pairwise relations presented in the Meaningful Texts to aid them in their recall of the premises, but they were also using this information to produce Inference scores above and beyond those to be expected on the basis of the Proposition scores.

More important, however, is the interaction between inferences varying in the degree of applicability of world knowledge and age. For those inferences requiring an obligatory reference to implicit world knowledge, inferences which bear a close similarity to those an individual is required to draw in regular oral discourse, there were no developmental differences. The Grade 1 children performed as well on the Implicit Inferences as the Grade 5 children. Marked developmental differences did occur, however, on those inferences requiring little reference to world knowledge (i.e., Formal L1 Inferences) or contradictory reference to world knowledge (i.e., Counter Factual

Inferences). Consider now the subjects' performance on these various Inference types in greater detail.

All the children found the Counter Factual Inferences to be the most difficult. The percent correct scores for the Grade 1, Grade 3 and Grade 5 children were 58%, 59% and 74% respectively. Both of the two younger grades were performing at about chance level. Only the Grade 5 children were able to produce Counter Factual Inferences. Note, however, that the younger children were not simply responding on the basis of what they know to be true, since their scores were at chance rather than below chance.

The Grade 1 children performed at a similarly poor level on the L1 Formal Inferences (56% correct). The performance of the Grade 3 children improved considerably however, to 69% correct, while the performance of the Grade 5 children was better still, close to the level obtained for the Counter Factual Inferences (75% correct). These data, then, support Piaget's and Frase's findings that young children are unable to draw logical implications.

The scores of all the children were considerably increased on the Meaningful L2 Inferences. The percent correct responses for the three garade levels were 80%, 84% and 94% indicating that it is easy to produce inferences from material which calls upon world knowledge even if the structure of the material is formal. These data on L2 Inferences contradict Frase's and Piaget's claim that children are unable to draw logical implications.

What, then, determines whether children will be able to produce the implications of a statement? Consider this question in the light of research by Trabasso and Riley (1974) and Ann Brown (1976). Recall that Trabasso and Riley gave their subjects a transitivity task providing the children with over-learning on the pairwise relations. The performance of the subjects in this study parallels the performance obtained by Trabasso

and his co-workers; overlearning on the pairwise information is not the only way to enable the child to draw formal implications. Our provision of a rationale for the pairwise relations based upon general knowledge of the world, even if the child hears it only one time, produces an equal increment in performance. But note also that the low performance of the youngest children on the L1 Formal Inferences indicates that children are unable to construct their own causal links between premises until age 8-12 years, or so.

Ann Brown has recently reported a study in which pre-school to fourth grade subjects were required to construct and reconstruct the logical sequence described in a series of pictures. Brown found that even the youngest children were able to perform the task efficiently. However, the ordering of the concepts considered by Brown was not potentially arbitrary; given the story theme the concepts could only be ordered one way. The subjects in this study thought were given information which ordered only pairs of concepts, and they were unable to use one rationale to order all the concepts, indeed to have done so would, in some cases, have resulted in the production of an incorrect array. Clearly, more research is needed to determine the exact conditions under which children are able to raise their performance on logically structured material from the low level obtained on the arbitrary Formal material to the high level obtained with the Meaningful material.

The performance of the Grade 1, Grade 3 and Grade 5 children on the L3 Integration Inferences was 68%, 71% and 82% respectively. While the subjects performed less well on the L3 Inferences then they did on the L2 Inferences, the observed performance was still better than that obtained

in earlier studies by Moeser. Indeed, Moeser reported that subjects of college age performed less well (62%) than did the Grade 1 subjects in this study.

The children were required to draw the L3 Integration inferences from seemingly independent sentences in the Narrative stories, unlike the L1 Formate and L2 Meaningful Inferences which were derived from obviously structured material. Moreover, in the Meaningful Texts, not only were the inferences derived from well structured material, but also the world knowledge which aided the inference production was presented explicitly. When producing L3 Inferences, on the other hand, the subjects were obliged to extract the relevant world knowledge from memory. The relatively good performance on the L3 Inferences, performance which does not change dramatically with age, attests to the importance for all ages of being able to draw upon knowledge of the world.

Why did the subjects in this study perform at a higher level than did the subjects of Moeser (1975); Paris & Carter (1973) and Paris & Mohoney (1974)? The material used by these researchers was both arbitrary and relatively discontinuous: they presented their subjects with stories but the stories were only four lines long and were occasionally interspersed with other material. The subjects were therefore unable to use any meaningful episode or theme to aid sentence integration or inference production, resulting both in depressed scores and a lack of developmental differences.

As stated earlier, all the children performed well on the Implicit L4 Inferences and there were no age differences contrary to the findings of Paris and Upton (1976) who investigated the production of similar types of inferences. Two points should be kept in mind however. Firstly,

Paris & Upton used younger subjects than the ones tested in this study and inspection of their data reveals that it was the young Kindergarten subjects who contributed most to the developmental effect. Secondly, Paris & Upton used Yes/No questions, a technique which has been found to result in a response bias with young children. Many of the Implicit Inferences in this study were interogated by means of open-ended questions, which suggest that young children find it easier to produce their own answers.

What conclusions can be drawn about the development of the child's ability to draw inferences? The picture of language development which emerges from this study is that at first children learn to draw inferences from information which assumes or maps onto their prior knowledge; second, they learn to draw the necessary implications from arbitrary material; and third, they learn to draw the necessary implications from information which contradicts their prior world knowledge. Alternatively, development consists of learning to detach oneself from what is known and constain one's interpretation of linguistic information to what is explicitly stated, an ability which several authors (Cole & Scribner, 1974; Olson & Hildyard, in press; Scribner, 1968) have suggested appears to be a consequence of formal schooling.

Footnotes

[1]The distinction between inference and implication suggested by Dewey (1938) will be followed throughout this paper. Accordingly, an inference makes some reference to reality while for implications "the relations of meanings (carried by symbols) to one another is,... independent of existential reference" (p. 54).

[2]No transformations were performed on this proportional data. The cell variances were tested for homogeneity, with F max = 7.6 ($p < 0.05$). This non-homogeneity of variance was methodological rather than statistical and resulted from a ceiling effect with the Grade 5 children on L2 Inferences. Since ANCOVA is robust with respect to minor deviations from homogeneity and normality (Keppel, 1973) it was decided to leave the data untransformed.

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TABLE I

Examples of Text and Narrative stories.

FORMAL: The Circus

It was circus time again. All the children were excited. A large red tent was put up in the field outside town. Next to the tent were the animal cages where they kept the elephants, lions and horses. The band started playing when everyone was sitting in their seats. At the start of the show they had a parade. There were some clowns dressed in funny costumes with big red noses and funny hats. The clowns were in front of the elephants. There were six elephants and they plodded along slowly. Behind the elephants was the lion tamer. He was wearing a black suit and carried a long whip in his hand. Behind the lion tamer was the magician. As he walked along he was doing tricks. From his top hat he pulled some handerkerchieves and two white rabbits. As soon as the parade was over they dimmed the lights and the circus began.

MEANINGFUL: The Race

One day the animals in the jungle decided to have a race. They decided to start at the stream and see who could get to the old hut first. The winner's prize was some tasty food. On the day of the race, the animals met at the stream. As soon as they were all there, the monkey lined them up. Off they went. The giraffe with his long neck was able to see the best path to the old hut. The giraffe arrived there earlier than the elephant. The elephant was so big that he was able

to trample anything that got in his way, so the elephant arrived there earlier than the lion. The kangaroo wasn't able to go very fast as she had to make sure that her baby didn't fall out of her pouch. So the kangaroo arrived at the hut later than the lion. Then all the animals shared the winner's prize.

COUNTER FACTUAL: Getting Dressed

One morning Sammy got up in a rush. He hadn't heard his alarm clock go off. He jumped out of bed, grabbed his clothes and quickly got dressed. Sammy was in such a rush that he put his clothes on in a very funny way. He found his thick brown coat with the furry lining. He put his coat on before he put his jacket on. Sammy looked for the thick yellow sweater that his grandmother had made him. He put his sweater on after he put on the jacket. He decided to wear his green shirt. It had long sleeves and was very warm. He put on his shirt after he had put on his sweater. Then Sammy hopped on his bike and cycled to school.

NARRATIVE: The Kitten

One Saturday, Mrs. Smith left Jo and Robin alone in the house while she went to do some shopping. While the children were playing, they heard a knock on the door. They opened it and found a parcel on the doorstep. Jo and Robin took the parcel into the kitchen. They put it

TABLE 1

continued

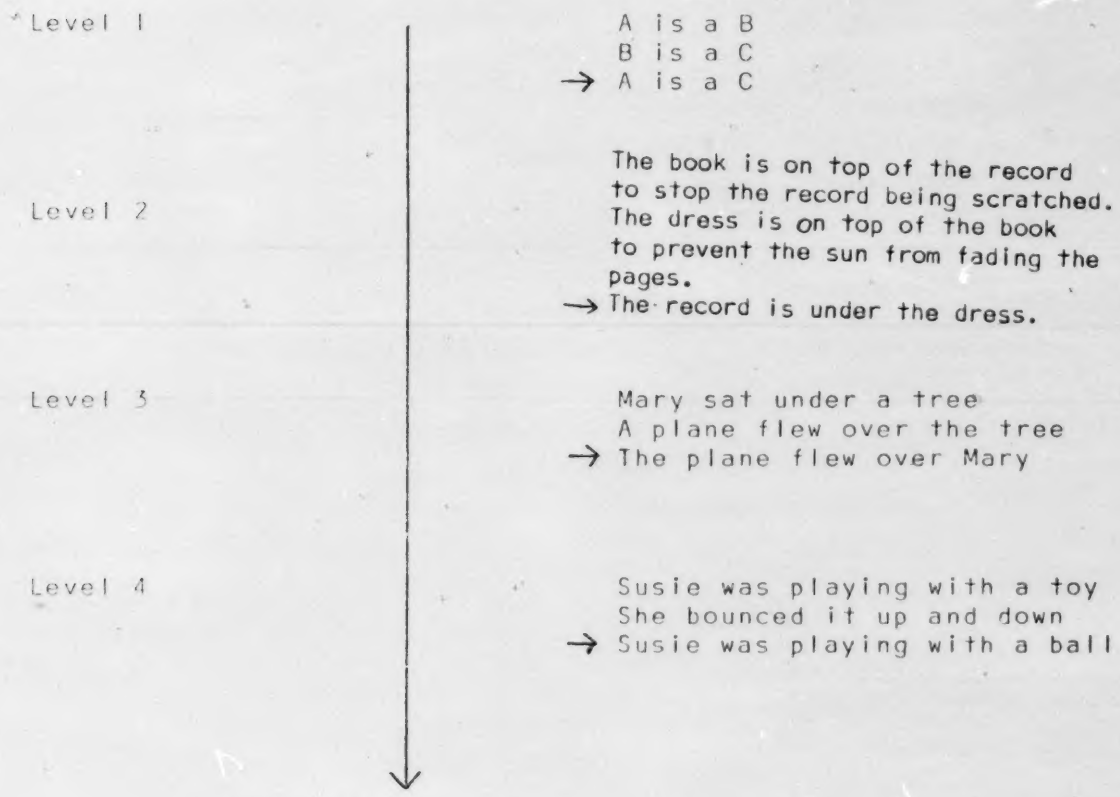
(page 3)

on the big red table. They undid the string and took off a sheet of brown paper. Then they took off lots of sheets of white tissue paper. Underneath was a basket. "Maybe Mum is buying us a kitten" said Robin.

When Mrs. Smith came home they helped her to unload the car but they didn't find a kitten. They got lunch ready and set the table and then Mrs. Smith told them to look on the back seat of the car. They brought the little kitten into the kitchen. It was white and very fluffy. The fluffy little thing had a black mark on its ear. They wondered what to call it. Mrs. Smith suggested Snowy but Jo and Robin decided to call it Twinkles.

Figure 1.

Representation of Inferences as lying upon a continuum of increasing amounts of world knowledge.


Level 1
A is a B
B is a C
→ A is a C
Level 2
The book is on top of the record to stop the record being scratched.
The dress is on top of the book to prevent the sun from fading the pages.
→ The record is under the dress.
Level 3
Mary sat under a tree
A plane flew over the tree
→ The plane flew over Mary
Level 4
Susie was playing with a toy
She bounced it up and down
→ Susie was playing with a ball
Increasing amounts of knowledge of the world

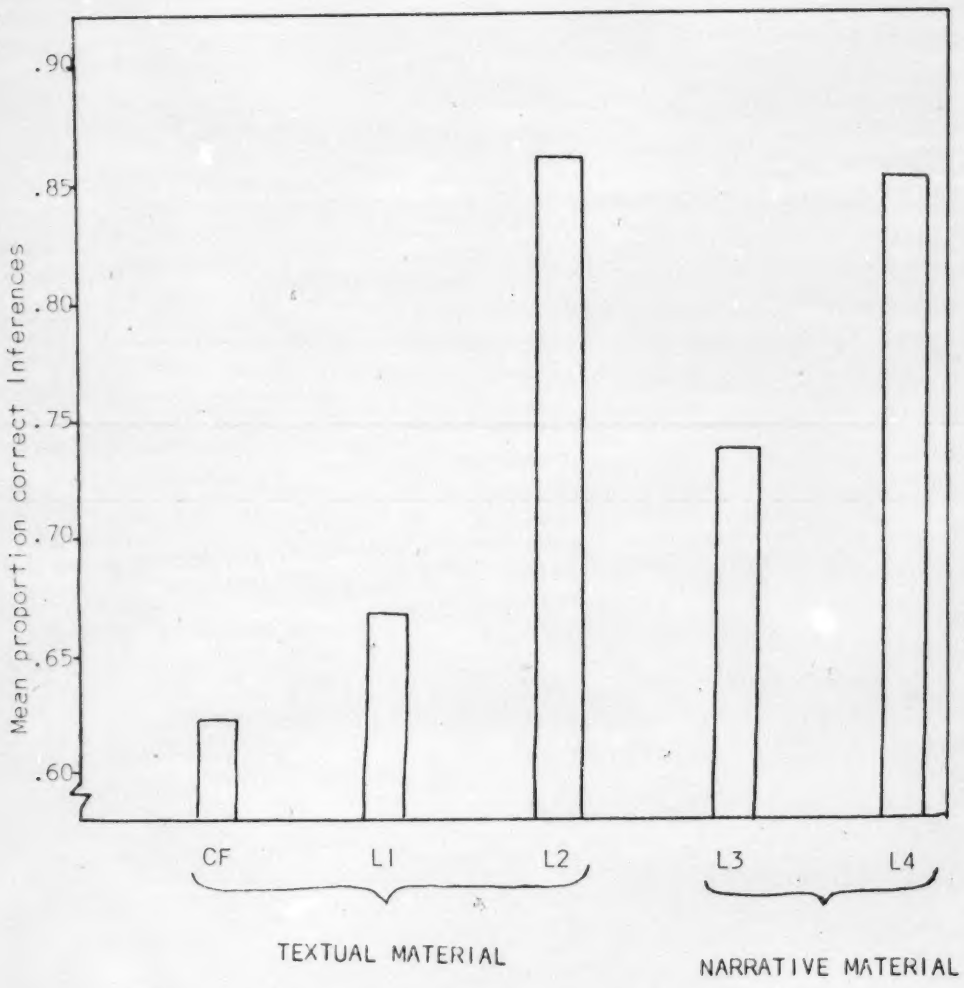


Figure 2

Difficulties associated with different types of Inferences.

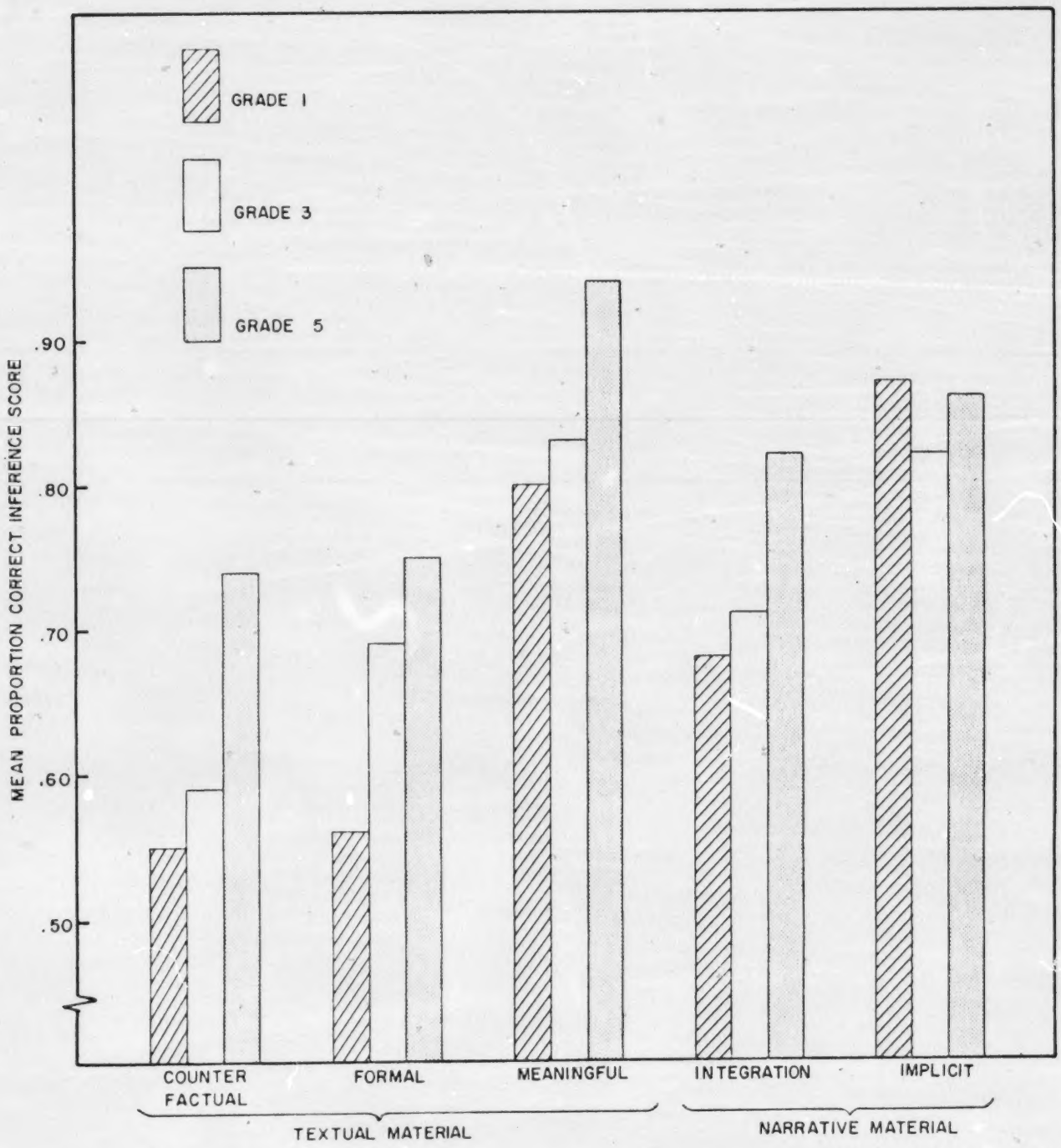


Figure 3

The effect of Grade level on the ability to produce different types of inferences.

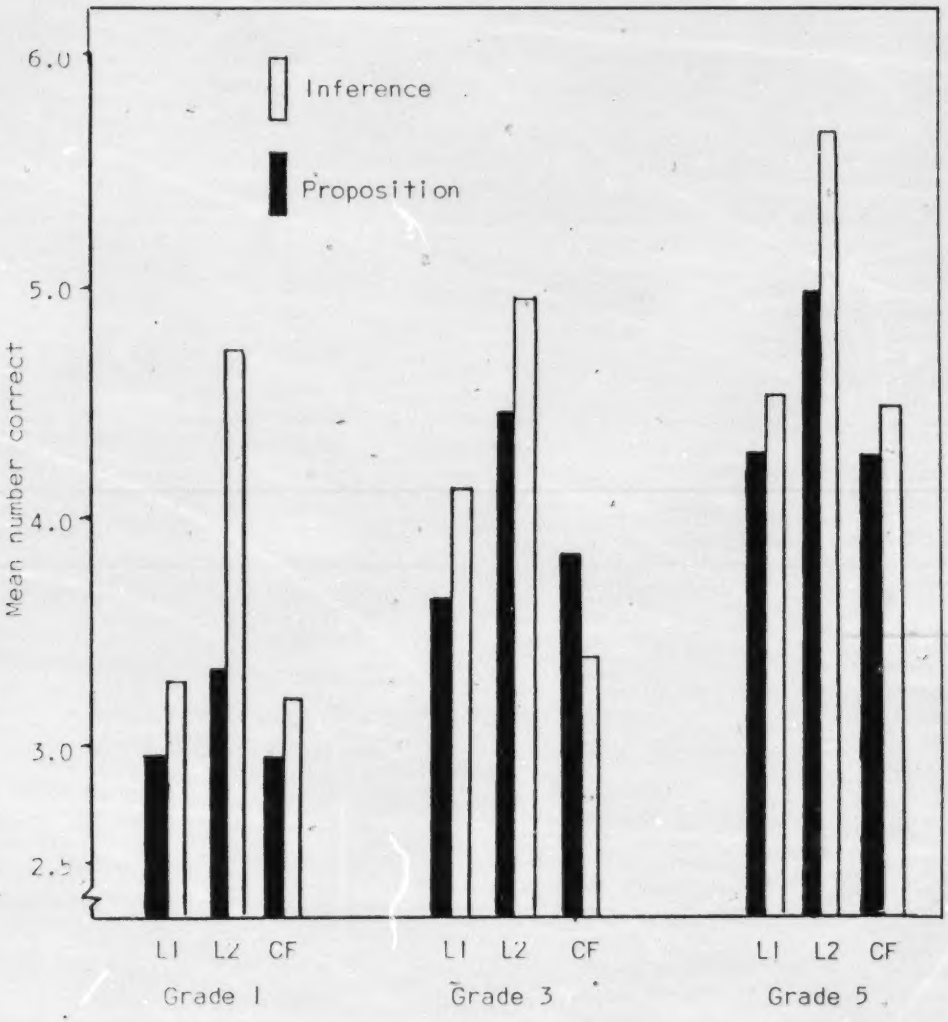


Figure 4

Inference and Proposition scores for Levels 1, 2 and Counter Factual Inferences for each Grade level